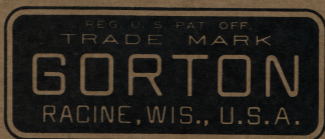


R. BROOKS

JUL 12 1937

INSTRUCTION BOOK and PARTS CATALOG

For Standard Type Pantograph Machines



This book to be used in combination with:

Accessories Catalog . . 1317
Copy Catalog 1309
Samples of Work Catalog 1370

Form 1385

GEORGE GORTON MACHINE CO.
RACINE, WISCONSIN, U. S. A.

1937 JUL 10 AM 8 33

57-131-944

INSTRUCTION BOOK and PARTS CATALOG

For Gorton Pantograph Machines • Standard Type •
Models 3-F, 3-U • 3-X, 3-Z • 3-S • 3-K • 3-H • 3-R • 1-H
also Parts List covering obsolete models
1-A, 1-C, 1-D, 1-J, 1-T, 3-A, 3-C, 3-G, 3-J.

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GEORGE GORTON MACHINE CO.
RACINE, WISCONSIN, U. S. A.

..FOREWORD..

Your Gorton Pantograph Machine is a precision tool, built to produce work of a high degree of accuracy. In order to maintain the adjustment within the very close limits which the machine receives before leaving the factory, it must, in the first place, be properly installed. After being placed in service, it will require intelligent care and handling.

It is the purpose of this Instruction Book to give briefly the information necessary for getting the machine ready for use, avoiding possible injury to delicate parts. Following this, directions for the adjustment, care and operation of the machine are offered to assist the operator in turning out the fine work of which the machine is capable.

Any questions that may arise which are not satisfactorily covered in this book will be gladly answered by our engineers. The George Gorton Machine Company's responsibility and interest does not end with the sale of a machine to you. It is our wish to co-operate with you in securing results that will more than equal your expectations.

It is by this policy that we gain not only new customers but friends, with the result that 70 per cent of our sales are repeat orders by present users of Gorton machines.

40 YEARS The Mark of FINE MACHINE TOOLS



UNPACKING and ERECTING

1. UNPACKING

Examine the box in which the machine is received to see that it is intact and that the machine has not been damaged in transit. All Gorton machines are shipped boxed tight, not crated, to eliminate dust or cinders and to prevent anything being thrust through the spaces of a crate to damage the machine. After removing box, check up all parts with the packing list. Carefully examine all packing paper and excelsior to make sure that no small parts have been overlooked.

2. CLEANING

For cleaning the machine of slushing grease, kerosene is preferable. The container used should be thoroughly cleaned before filling. Rags are better than waste as they leave no lint. When removing the grease from Pantograph, be careful not to immerse Pantograph in the kerosene and thus soak up the felt seals.

3. LOCATING THE MACHINE

All machines are completely assembled, ready for use, with exception of Pantograph, which is boxed separately. Before installing this, place the machine in desired location, close to a good window light if possible, opposite the center of window and *with the operator facing the window* (not the machine table). This is especially important if the machine is to be used for small delicate work, as daylight is always better than artificial light.

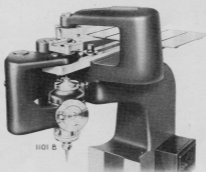


Fig. 1—Cutter Head Locked for Shipping

4. LEVELLING

Machine should then be levelled by means of a small machinist level placed on the machine table. While the base is drilled for lag screws, these are necessary only for shipping. It is important, however, that the machine be placed on as flat and solid a floor as possible.

5. SETTING THE SLIDER HEAD

With the wrench provided, loosen bolt "M" which clamps the Forming and Routing attachment to the Slider head.

The front end can then be pushed down (or gently pried and tapped with wood block) releasing the hinged cutter head and link. This cutter head and link is also held in the shipping position when it is desired to operate machine as a vertical miller or router with a fixed spindle. Now, with bolt "M" loosened, move the Slider head to the position indicating on the graduated scale at right side of head, the scale of reduction to be used. Then clamp bolt "M" firmly. This setting of Slider head need only be approximate without affecting accuracy of the machine.

6. PUTTING THE PANTOGRAPH IN PLACE

Now, holding Pantograph in position shown below, place SLIDER BAR "F" in SLIDER BLOCK "H", with index spot to the front. Then insert SLIDER BAR "B" in SLIDER BLOCK "E" with index spot toward "S". Take care that edges of blocks and bars are not dented or battered in this operation. These parts are carefully fitted and no force is necessary to slip the bars into the blocks, if started properly. After setting to the desired reduction and locking the bars in the blocks by means of the hexagon cap screws in each block, the machine is ready for use.

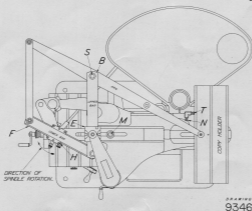


Fig. 2—Top View of Machine with Assembly Reference Points

LUBRICATION and ADJUSTMENT of 3-F, 3-U, (small size) MACHINES

UNPACKING and ERECTING

Same as page 3.

LUBRICATION

Correct grades of oils and greases:

Only pure neutral mineral oils and greases should be used. For lubricating the cutter spindle use only a light machine oil, similar to S.A.E. No. 20. Do not use 3 in 1, and similar very light oils. These may gum the bearings. For all other oil holes and oil cups either a light or medium machine oil. For all grease cups use a medium stiff grease equivalent to S.A.E. No. 3. For repacking Pantograph bearings only, use vaseline.

Oil twice a day:

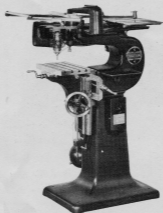
Cutter spindle, through oil hole "A" and "B", page 6. Guide pulley oil cups "C" and "D", page 5.

Oil once a week:

All other oil holes and oil cups. Run out work table to extreme positions and squirt a few drops of oil on table and saddle screws. Give drive pulley stud grease cup "E", page 5, one turn.

Once a year:

Remove grease plugs "F" on cutter head link, page 5, and inserting a grease cup or gun, fill. Remove the polished dust washers 6943-A, page 5, covering Pantograph bearings, by inserting a thin bladed knife in the washer slot. Repack bearings with vaseline, packing it in tightly so as to force new supply into lower bearing. Snap washers back into place with fingers. Remove nuts 3336-A, page 6, which hold Pantograph link and repack these bearings. Remove cap 7110-A, page 5, and repack chamber with cup grease.



3-U Machine

THE CUTTER SPINDLE

Spindle has non-adjustable bearings which automatically take up wear and require no attention except oiling. The spindle is quickly removable and should trouble of any kind develop, we suggest that it be returned to us for overhaul, which will be done promptly and at nominal cost as there is very little to wear on these spindles.

THE PANTOGRAPH

Pantograph needs no care except occasional greasing as above. Should play develop in the joints after several years' use, it can

easily be removed by tightening nuts 3336-A on pantograph studs 3263-A, page 6. These should be tightened very slightly, as too much will cause the balls to cut into the cups causing rapid wear and inaccuracy. Before tightening, loosen cap screw 365-A-E on cutter head, page 5, to allow Pantograph to realign itself properly. Then remove Pantograph entirely and test the Pantograph block 226-A attached to slider head and Block 224-A attached to cutter head, taking these up first. Then insert Pantograph in slider head block only, with cutter head swung out of the way, and test Pantograph bearings.

THE CUTTER HEAD LINK

Cutter head link bearings should not require attention other than greasing. If, after several years, these become a trifle loose, they can be taken up by loosening slightly (not entirely) the Bristo cap screw "G", page 6, and tapping downward against top of the plug 8713-A.

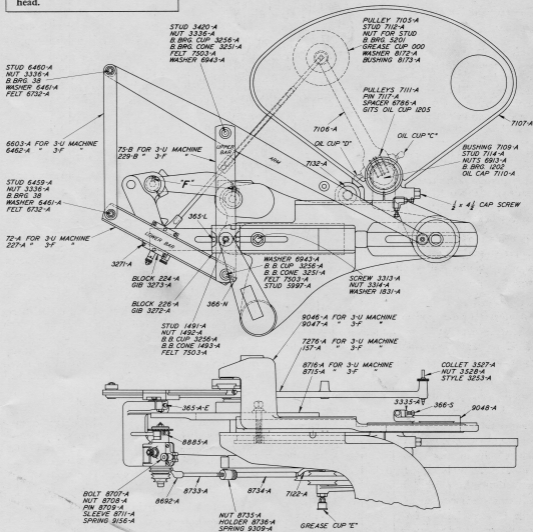
GENERAL CARE

The machines should be thoroughly cleaned at least once a week and the scraped ways wiped clean and oiled.

Mechanical specifications and complete description in Booklet 1321. Areas covered at one setting shown actual size at rear of this book. Accessories for use with these machines in Accessories catalog 1317. Copy for use with these machines in Copy catalog 1309.

ASSEMBLY and PARTS DRAWINGS for 3-F, 3-U, (small size) MACHINES

When ordering repair parts, give serial number, which will be found on pad at top of slider head.



PANTOGRAPH ASSEMBLY
No. 3-F & 3-U ENGRAVING MACHINE.

DRAWING
9342

LUBRICATION and ADJUSTMENT of 3-X, 3-Z, (medium size) MACHINES

UNPACKING and ERECTING

Same as page 3.

LUBRICATION

Correct grades of oils and greases:

Same as page 4, for 3-F, 3-U machines.

Oil twice a day:

Cutter spindle, through holes "C" and "D", page 9. Oil cup, 301, page 9. Guide pulley oil cups 1205, page 8.

Oil once a week:

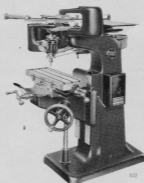
All other oil holes and oil cups. (Do not forget to replace oil hole plugs). Run out table to extreme positions and squirt a few drops of oil on table and saddle screws. Lift the knee elevating screw cover and squirt a few drops of oil on screw. Give drive pulley stud grease cup 000, page 8, one turn, also cutter head link grease cups 00, page 8.

Once a year:

Remove the polished dust washers 6795-A, page 8, covering the Pantograph bearings, by inserting a thin bladed knife in the washer slot. Repack bearings with vaseline, packing it in tightly so as to force a new supply into lower bearing. Snap washers back into place with fingers. Remove nuts 6208-A, page 8, holding Pantograph link. Repack these bearings with vaseline. Remove cap 7110-A, page 8, and repack chamber with cup grease equivalent to S.A.E. No. 3.

THE CUTTER SPINDLE

Spindle has no adjustable bearings and requires no attention except oiling. If, after several years of use, the spindle becomes inaccurate through ball bearing wear, new ones can be inserted at low cost which will make the spindle as accurate as new. Care should be taken not to use cutters more than one or two thousandths undersize. Smaller ones require the collet nut to be pulled up very tight to prevent cutter slippage and may permanently spring the spindle, causing cutters to run out of true.



3-Z Machine

On machines equipped with removable spindle 698-1 the same instructions apply as above, with this addition: When spindle is removed from machine, care should be taken to prevent small chips and grinding dust from lodging around top seal. Always clean outside of spindle thoroughly before inserting in machine.

THE PANTOGRAPH

Pantograph needs no care except occasional greasing as above. Should play develop in the joints after several years of use, it can easily be removed by tightening nuts 6913-A on Pantograph studs 6184-B, 6185-B, pages 8 and 9. These should be tightened very slightly, as too much will cause the balls to cut a groove in the cups causing inaccuracy and rapid wear. Before tightening, loosen hex. cap screw "E" on cutter head (page 8) to allow Pantograph to realign itself properly.

THE CUTTER HEAD LINK

Cutter head link bearings should require no attention except greasing. If, after several years of use, they become loose, they can easily be taken up by loosening the Bristo set screws "F" at top, page 9, and tightening slotted head adjusting screws 6359-A. This should rarely if ever be necessary.

TABLE GIBS

Table gibs are tapered with adjusting screw at one end of gib and locking screw at other end. To tighten gib, loosen locking screw at small end of gib, tightening the screw at opposite end as required. Knee gib has a tapered side and a glance will show how to take it up.

GENERAL CARE

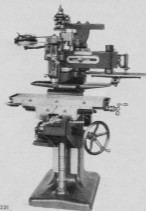
The machine should be thoroughly cleaned at least once a week and the scraped ways wiped clean and oiled.

Mechanical specifications and complete description in Booklet 1321. Areas covered at one setting shown actual size at back of this book. Accessories for use with these machines in Accessories catalog 1317. Copy for use with these machines in Copy catalog 1309.

LUBRICATION and ADJUSTMENT of *3-S (large size) MACHINE

UNPACKING and ERECTING

Same as paragraphs 1, 2, 3, 4, 5, page 3. 3-S machines are shipped with Pantograph completely assembled, except on machines for export, when the Pantograph is disassembled and boxed separately. For all domestic shipments, a special casting is made, fitting around cutter spindle and clamped to table of machine. Loosen the bolts holding this casting and remove. The machine is then ready to operate.



3-S Machine

LUBRICATION

Correct grades of oils and greases:

Same as page 4, for 3-F, 3-U machines, except S.A.E. No. 3 grease is used exclusively in Pantograph bearings also. No vaseline.

Oil twice a day:

Cutter spindle, through oil cup "A", page 12.
Cutter spindle drive pulley 6536-A, page 12, through oil hole "B".

Oil once a week:

All other oil holes and oil cups. Run out table to extreme positions and squirt a few drops of oil on table and saddle screws. Lift the knee elevating screw cover and squirt a few drops of oil on screw. Give all grease cups one turn and Alemite fittings one shot, except Pantograph bearings, which are only necessary to lubricate twice

a year. *Once a year:* The cap 7110-A, page 11, should be removed and chamber repacked with grease.

THE CUTTER SPINDLE

Cutter spindle has no adjustable bearings and requires no attention except oiling. If, after several years of use, the spindle becomes inaccurate through wear of the ball bearings, new ones can be inserted at low cost which will make the spindle as accurate as new. Care should be taken not to use cutters more than one or two thousandths undersize, as smaller ones require the collet

nut to be pulled up very tight to prevent cutter slippage and may permanently spring the spindle, causing cutters to run out of true.

TABLE GIBS

Table gibs are tapered with adjusting screw at one end of gib and locking screw at opposite end. To tighten gib, loosen locking screw at small end of gib, tightening the screw at opposite end as required. Knee gib has a tapered side and a glance will show how to take it up.

GENERAL CARE

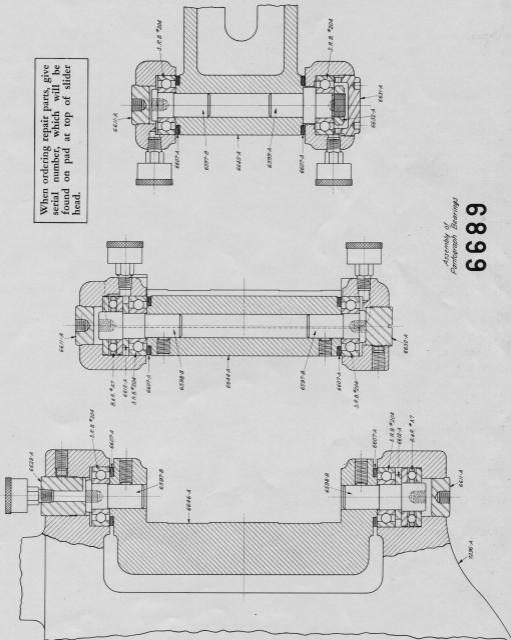
The machine should be thoroughly cleaned at least once a week and the scraped ways wiped clean and oiled.

*NOTE: All instructions on this page also apply to model 1-S machines, now obsolete. The improvement in design has not altered construction or operation of any essential parts of the machine.

Mechanical specifications and complete description in Booklet 1226. Areas covered at one setting shown actual size in rear of book. Accessories for use with these machines in Accessories catalog 1317. Copy for use with these machines in Copy catalog 1309.

ASSEMBLY and PARTS DRAWINGS for 3-S (large size) MACHINES

When ordering repair parts, give serial number, which will be found on pad at top of slider head.



Assembly of
Pumpkin Bearings

6689

LUBRICATION and ADJUSTMENT of 3-K, 3-R, 1-H, 3-H MACHINES

UNPACKING and ERECTING

Same as page 3 for all models above.

LUBRICATION

The correct grades of oils and greases for all of the above models are the same as given on page 4. Follow the oiling instructions given on page 7 for models 3-K, 3-R and 3-H, and on page 4 for model 1-H.

ADJUSTMENT

The 3-K, 3-R and 3-H models are adjusted as described on page 7, except all 3-K machines are equipped with removable cutter spindles. Instructions for adjusting 3-K cutter head links are the same as for 3-F, 3-U machines on page 4.

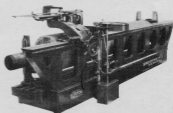
Model 1-H is adjusted as described on page 4.

IMPORTANT 3-K INSTRUCTIONS

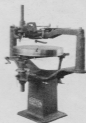
Before attempting to adjust or disassemble the ball bearing cutter head auxiliary support, as shown in drawing 7554-B on page 8 of booklet 1242, send to factory for complete assembly drawings of these parts and instructions. This entire assembly must be in perfect alignment to insure smooth and accurate operation, and it can easily be thrown out of adjustment or damaged by incorrect adjustment.

For additional instructions on these machines consult the following specification booklets:

3-K	see Booklet 1242
3-R	see Booklet 1256
3-H	see Booklet 1060
1-H	see Booklet 1057



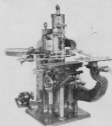
3-R—No. 1250-R



1-H—No. 1081



3-H—No. 1175-B

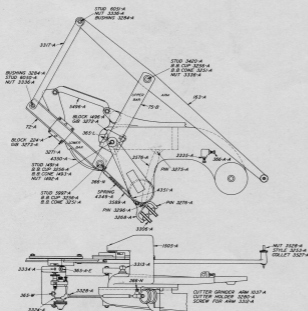


3-K—No. 1255

Accessories for use with these machines in Accessories catalog 1317. Copy for use with these machines in Copy catalog 1309.

LUBRICATION and ADJUSTMENT of MODELS 1-D, 3-D

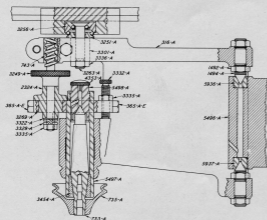
(These Models Now Obsolete)



PANTOGRAPH ASSEMBLY
No. 1-D ENGRAVING MACHINE.

DRAWING
9383

Areas covered at one setting for all machines listed on these two pages shown actual size on rear flap of this book. Accessories for use with these machines in Accessories Catalog 1317. Copy for use with these machines in Copy Catalog 1309.



CUTTER HEAD ASSEMBLY
No. 1-D ENGRAVING MACHINE.

DRAWING
9382

When ordering repair parts, give serial number, which will be found on pad at top of slider head.

NOTE: Instructions for the lubrication and adjustment of models above is identical with page 14. These 1-D, 3-D models cover greater range however, which makes necessary the slightly different assembly and parts drawings.

HOW TO OPERATE: SETTING THE PANTOGRAPH, USE OF COPY, MASTERS AND TEMPLATES

1. Setting the Pantograph

The copy is laid out to keep within the range limits of the Pantograph. See the charts in the rear of this book. The setting of the Pantograph is then determined from the size of the work to be engraved.

2. Example: If length of copy is 10" and length of job desired is 2", divide the length of job into the length of copy: $2")10"=5$. Therefore, set your Pantograph bars at reduction 5. If length of copy is 11" and length of job desired is 4", then the reduction is $4")11.00"=2.75$. You will note that reduction 2.75 is *not* marked on Pantograph bars. To find it, look in rear of this book at correct Reduction Chart for your machine. If it is not found there, it can be obtained by using the reduction formula, also at back of book.

3. All settings are measured from the first reduction on any machine. On some models this begins with reduction 3, on others it is marked 1 and 2. In setting the slider blocks in this manner, for special reductions, use a hundredth inch scale and magnifying glass, if accurate work is required.

4. To set the Pantograph, proceed as outlined in paragraphs 7 and 8, page 3. Never force the Pantograph bar blocks by striking with a hammer or any hard object. These blocks are tested before leaving the factory and, if at any time while setting the Pantograph, you find these blocks too tight, ascertain the cause. It may be that you have not loosened the nuts sufficiently, or they have become gummed with oil.

5. Use of Copy, Masters or Templates

The originals from which reproductions are made are known by various terms. "Copy" is the term most used. It applies specifically to the standard brass letters or type which are set up in the copy holder of the machine and which guide the Pantograph in reproducing. Shapes as distinguished from characters are also called masters, special copy, or templates.

6. Over 700 sizes and styles of special copy are listed in our 48 page Copy catalog. The examples shown on page 1 of the Copy catalog will give a good idea of the variety of forms available for Pantograph work. The setting up and use of standard copy on the machines, ordering instructions, etc., are given on pages 2 and 3 of the Copy catalog. For making up copy in special shapes, the descriptions on pages 20 to 27 of the Copy catalog will be found helpful.

7. The numerous illustrations of actual work, produced with various kinds of copy, in our 32 page Samples of Work catalog (pages 7, 11, 12, 13, 18, 20, 27, 29) will also be helpful in considering copy.

8. Copy is not strictly self-spacing, therefore the spaces between the characters should be adjusted by inserting suitable blank spacers which are furnished with each set of copy. Each line when set in the copy holder should be confined without shake between the clamps furnished, as shown on page 2, Copy catalog.

9. After setting up the copy in the holder, and before engraving, be sure that the holder is firmly against the stop screws "N" or "T" (page 3) in copy holder base. It is then square with table. Do not disturb these stops. They are properly adjusted when machines leave factory, and any change will throw copy holder out of square with table. T slots in the machine table are also parallel with front edge of table. This is also true of T slots or dove-tail grooves in copy holders. This makes it easy to set up work and copy in accurate parallel relation to each other.

10. When several lines of reversed copy are set up in a copy holder, an easy way to check for spelling and position of characters is by making a rubbing with a sheet of tissue, then look on reverse side and read.

HOW TO OPERATE: MAKING SPECIAL COPY FROM VARIOUS MATERIALS

Bristol Board

When sunk, Vee groove characters or designs are to be cut in fairly soft materials as wood, bakelite, fibre and sometimes brass, the design may be drawn on or transferred to a piece of Bristol board. Then, using a small knife or tool with a beveled edge ground to 90 degrees included angle, and having a slightly dulled point, run over the drawn lines. Press fairly hard so as to get a line $1/64"$ to $1/32"$ deep. Now smooth over this line with a hard lead pencil having a point approximately 90 degrees also. This smooths out the roughness. Then give the whole a coat of shellac for added stiffness. Bristol board copy should always be made up 3 to 10 times larger than the work, and never used to produce very accurate work.

Transparent Celluloid

Celluloid of any thickness that is transparent, preferably about $1/16"$, can be conveniently used as master copy for cutting in harder materials than given above under Bristol board, and is satisfactory for light cutting in steel. It is largely used for jewelry dies and other dies and molds where the entire design is cut sunk in the die or mold. The transparency of this material permits laying the drawing under the celluloid and cutting in the lines as described above, using a hollow ground 45 degree angle hand graver. It is not necessary to go over the lines with pencil or to shellac as it is with Bristol board. An oily rag rubbed over the celluloid copy will cause the tracing style to follow the grooves more freely.

Linoleum

Linoleum such as artists use making block prints, about $1/8"$ thick, is also suitable for light cutting in steel and for the same character of work as the celluloid. We find that for linoleum it is best to cut in the designs, using a round nose tool instead of an angular one. The tracing style of machine is then rounded to conform and polished

for greater smoothness. A little oil rubbed on the copy helps the tracer to slide smoothly.

Brass

All Gorton standard copy is made of brass. It is the material most generally used where a permanent copy is desired and where it is necessary to do heavy cutting. Get Engraver's brass such as listed on page 21 of Copy catalog. Ordinary brass is hard to work, and raises a burr when cut. Since brass is so much harder than any of the foregoing materials, it is not practical to work it with a hand tool and it will be found necessary to rout in the designs on a vertical miller, or by using the Pantograph machine spindle locked in the routing position. Swing the radii required for characters and designs with a circular table or by means of the graduated circle copy illustrated on page 22 of Copy catalog. This latter device will be found very convenient even where a circular table is already at hand.

Zinc

Zincs made by a photo-engraver, direct from a drawing, are often used for reproducing raised patterns of intricate design in steel dies. This process eliminates practically all hand work in producing the master, frequently saving much time. A drawing of the design, exact size of master desired or enlarged, is given to the photo-engraver and he reproduces it to the desired size in the zinc. Special instructions should be given to etch the plates deeper than standard for ordinary printing practice $1/32"$ deep if possible. Before using the zinc on the Pantograph machine, trim up all the lines to eliminate any ragged edges, and leave a square bottom to the etching.

Steel

For production work where copy will be traced thousands of times and subjected to continual hard use, steel copy, hardened, is often used. This is particularly true where heavy cutting will be done, such as the profiling illustrated on pages 25 to 28 in Samples of Work catalog.

HOW TO OPERATE: COPY HOLDERS ... USE OF TRACING STYLES

Fig. 3—Copy Set up in Copy Holder



Copy Holders

Copy is held on the machine by means of the copy holders provided for that purpose. A number of different styles and sizes are provided. These are illustrated on page 14 of Accessories catalog. Where special copy is used exclusively, we recommend holder 8-2, or for very large copy plates, holder 36-1. Gorton standard brass copy characters have beveled edges fitting the beveled groove holders. All these holders are interchangeable, and can quickly be removed from the machine whenever the work requires different sizes of copy, etc.

Use of Tracing Styles—Kinds

Two different kinds of tracing styles are used with Gorton Standard Pantograph machines. For all cutting of sunk letters and designs from 90 degree Vee groove copy, as shown on page 2 of Copy catalog, style No. 3253-A (page 9, Accessories catalog) is used. For cutting sunk letters and designs from square bottom groove copy, also for relief (raised) letters and designs from relief copy, the 25-1 or 286-1 tracing style sets are used. See Accessories catalog, page 9.

Care and Use of Style 3253-A

This style should be kept ground to a cone of 90 degrees included angle in a Gorton cutter grinder by means of the 2/10" dia. collets which can be supplied for this purpose. See page 7, Accessories catalog. If the grinder is not of the collet type, use the small V block attachment furnished, and the small collar which slips on style. All sunk Vee groove copy is made to 90 degree angle and if the style is not accurately ground to this angle and kept sharp, the copies will soon be damaged so as to cause imperfect lettering.

Keep copy grooves clean by rubbing out several times a day with a slightly greasy rag. This takes but a few seconds and style moves over the copy with much less effort. The style, when placed in

the lines of the copy, should be clamped in its collet on the long arm of the Pantograph in such a way that no excessive straining of the Pantograph joints is caused. The slight springing when the style is moved from one letter to another will do no harm.

Care and Use of Styles 286-1, 25-1

These are for engraving raised letters and designs, or sunk lettering in which the thickness of line is not uniform, as it is with plain block letters. Where the reduction ratio is large, the styles and rollers 25-1 are used. Where it is small, and for final finishing, the styles without rollers (286-1) are used.

If the cutter is in the exact ratio of reduction to the styles to which the Pantograph is set, the forms engraved will be accurately proportioned to the forms of the copy. The exact size may be conveniently calculated in decimals of an inch by reducing the diameter marked on the roller in the ratio of reduction to which the Pantograph is set. Thus, if the Pantograph be set to reduce to one-tenth the size of copy, a cutter .06" diameter must be used with the .6" roller. It is generally desirable to use the largest roller with a proportionately large cutter to do the rough work of outlining and removing the bulk of the stock, and to use the smaller rollers, or styles alone, with corresponding cutters, only when necessary to reach into fine spaces or corners of the work.



Fig. 4
Using Sunk Vee Groove Copy on Machine

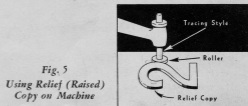


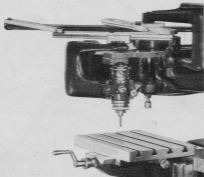
Fig. 5
Using Relief (Raised) Copy on Machine

HOW TO OPERATE: ... USE OF FORMING GUIDE

For curved work on all Gorton standard type Pantograph machines a hardened steel forming guide is necessary, in addition to the flat copy or master template. A forming guide in operation is illustrated here, also described on page 3 of the Samples of Work catalog. A typical assortment of forming guides for different kinds of curved work is shown on page 21 of the same catalog.

If the work is of a concave nature, then a forming guide block should be made (preferably of tool steel, hardened) the *exact opposite* of the work or *convex*. On page 16 of Accessories catalog is illustrated *adjustable forming guides*. These guides may be adjusted in a few seconds to almost any desired curvature, and eliminate the necessity for making up expensive hardened guides from a solid block of steel on many jobs. The forming guide is secured to the forming bar by means of four small screws, in the position shown in the small cut on page 3 of Samples of Work catalog. Assuming that your work is secured on work table, and copy on copy holder, you are ready to proceed as follows:

1. Lock spindle floating movement and locate work in relation to copy.
2. Release spindle floating movement and allow former point to come in contact with guide, which should be approximately over work.



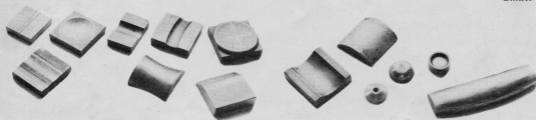
Forming Guide in Operation

3. Extreme care should be observed in locating forming guide in relation to work. Place a round cutter blank, ground to a conical point, in the cutter spindle (or use flexible tracer 68-1, page 5, Accessories catalog) and raise work close to cutter or tracer. Now move cutter point over surface of work by moving tracing style. If the point does not follow the concave or convex surface of the work, then move work table in direction necessary.

4. When your work is in direct relation with the forming guide, the copy will be found out of alignment with work, due to moving the table.
5. Your copy should now be located by shifting it back and forth and placing tracing style at extreme points, noting when cutter point locates laterally with work. After lining up, lock the table and do not move again.
6. Cover forming guide with grease so former point will slide without friction.

Once this has been done, the engraving can proceed. In other words, after you have located your work, etc., the forming guide can be entirely forgotten as it requires no further attention. The spring in the spindle will always keep the former point secure against the guide, thus causing the cutter to follow the same course of the forming guide surface.

Typical Forming Guides



CUTTERS ... MATERIALS & CUTTING LUBRICANTS

Cutter Steels

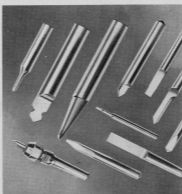
For average work in steel, cast iron and brass, the best cutting tools we have found are high speed steel. For a limited amount of work which requires a very keen, hard cutting edge, but no high speeds or feeds, our Special Carbon steel is best. (See bottom page 2, Accessories catalog).

Cutters of New Hard Alloys

We have tested the new hard alloy cutters known by trade names such as Carboloy, Widia, Ramet, etc., and recommend them very highly for cutting soft abrasive materials like Bakelite, hard rubber, celluloid and all other synthetic plastics. On these materials such cutters have 15 to 20 times greater life between grinds than the best high speed steels. On tests we have cut the equivalent of 50,000 letters $\frac{1}{8}$ " high in Bakelite panels without regrinding cutter, and without the cutter showing appreciable wear. On rubber rolls we have used similar cutters for 50 hours without regrinding. For all this work we list on page 4, Accessories catalog, Tungsten-carbide blanks for insertion in 21-2, 22-4 collets (listed in Accessories catalog page 6) also larger dia. blanks for holding in regular collets.

Characteristics of New Hard Alloys

These cutters are not suited, however, to work requiring frequent grinding of tip to various angles and clearances, since they are almost as hard as a diamond and require special wheels for grinding. These cutter materials are formed of very hard small grains held together by a bond. On account of this granular structure it is almost impossible to grind such cutters to a fine, keen point for the very finest line engraving, but points small enough for engraving $\frac{3}{32}$ " and $\frac{1}{8}$ " high characters can be maintained. We have



*Sample Cutters Used on Gorton
Pantograph Machines*

special equipment for grinding these cutters and can supply any angle and clearance, or customer can grind them (see Grinding, page 22).

Ordering New Hard Alloys

These new hard alloys are made in a great many different grades and hardnesses for every condition of service. In ordering such cutters, it is necessary to state the materials desired to cut, and general information regarding operating conditions, to insure receiving correct grade and type.

Diamond Cutters

For engraving lettering on glass and hardened steel, diamond cutters can be furnished, see Accessories catalog, page 4. They will engrave a line .003" to .005" deep. They are run at 10,000 R.P.M. or more.

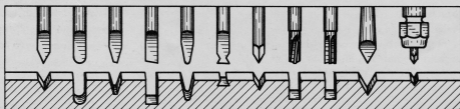
Cutting Lubricants

For all grades of steels shown on the chart, page 26, any good cutting oil or mineral lard oil is best, although it is not always necessary to use a lubricant with small cutters. These oils can be obtained from such concerns as Standard Oil Company, Sun Oil Co., E. F. Houghton, etc. For cast iron, Bakelite (and associated materials on chart) also brass, no lubricant is necessary. Houghton's "Fropol" is good for cutting stainless steel and Monel metal, although these new steels are made in over 30 different grades, with greatly varying characteristics.

For fine cutting in aluminum or to avoid burrs, use half lard oil and kerosene, mixed. For engraving glass or hardened steel with a diamond cutter, flood the work with turpentine and do not allow to dry.

For cutting plastics or cast iron with the new hard alloy cutters as Carboloy, Widia, etc., no lubricant is necessary.

GRINDING CUTTERS .. SHAPE OF POINTS .. WHEELS



Typical Cutter Points and Cuts

General

The importance of correct grinding of the cutters used on Gorton Pantograph machines cannot be stressed too strongly. Satisfactory work cannot be produced if the cutters have been incorrectly ground. The following instructions on cutter grinding should be read and carefully followed. It is *absolutely essential* that suitable equipment be available for grinding the small cutters used with Gorton machines. If you do not have such equipment, we would suggest the purchase of a Gorton 375-1 or 265-4 grinder, as shown in separate booklet. Both these machines do the same class of work and operate in the same manner. The 375-1 is the more expensive and has many refinements not incorporated in the 265-4.

If no cutter grinding equipment is available, Gorton taper shank cutters can be ground on the Pantograph machine by using the mounted wheels described on page 10, Accessories catalog. Use maximum speed of 8,000 R.P.M. (The attachment will not handle straight shank cutters.) These have a taper shank and fit in the cutter spindle. The cutter is held by Attachment 288-1 illustrated on page 11, Accessories catalog. We do not recommend this method unless it is impossible to purchase a cutter grinder, as it throws grinding dust over the machine which works into the slides and bearings.

Shape of Cutter Points

Practically all of the cutters used in Gorton Pantograph machines are of the single lip type. A typical assortment is illustrated above. Occasionally for special work, 3-, 4 or 6 sided cutters like cut above, are used. Standard spiral flute end mills are also used for side milling, as in profiling, and

for some types of die-cutting. Reference to pages 2, 3, 4, 5, 6, 7, of Accessories catalog will show suitable cutters, with collets, etc., for holding. In general, the single lip straight shank cutters are used for heavier work, and the Gorton taper shank type for the lighter engraving of small characters and designs.

Single lip cutters are usually ground with a conical point, the angle depending on depth and width of face required. A table of suggested angles and clearances for different types of work is given on page 25.

Grinding Wheels

The wrong grade of wheel will easily draw the temper of small cutters and make them soft. Use the correct grade of wheel. Suggested grades for different purposes are listed on page 10 of Accessories catalog. Dress wheels frequently with the diamond dresser provided, and also listed in Accessories catalog. This is very inexpensive and will repay its small purchase price many times over. (One is furnished with each Gorton grinder.) Occasionally go over wheels after diamond dressing with a star wheel dresser. Keep wheel free of grease and avoid touching with greasy fingers. Never grind continuously in one spot; keep tool moving. Keep wheel spindle snug and free from vibration.

Special wheels for grinding and lapping the new hard alloys are listed on page 10 of Accessories catalog. These permit much faster grinding and lapping of these materials than heretofore possible. When grinding tungsten carbide tools dry, never dip in a coolant,—it may cause checking. Do not force the tool against the wheel,—use light pressures only.

GRINDING CUTTERS WITH GORTON CUTTER GRINDERS

Truing Grinding Wheel

True up grinding wheel, using diamond tool 7566-A (page 11, Accessories catalog) which is furnished with grinder. This tool has a taper shank and can be inserted in grinders having tool heads fitting Gorton taper shank tools only, or it can be held on its diameter in a $\frac{3}{8}$ " collet in any of the collet type tool heads. After inserting the diamond, set the tool head at approximately the same relation to the wheel shown in Fig. 1. Then swing across face of wheel by rocking the tool head in much the same manner as for grinding a cutter.

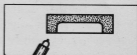


Fig. 1—Truing Wheel

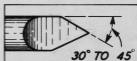


Fig. 2—Set Tool Head to Desired Cutter Angle

Grinding Conical Point and Cutting Edge.

Set tool head of grinder to angle desired on cutting edge. This usually varies from 30 to 45 degrees, depending on the work desired. See Fig. 2. Now place cutter in tool head and rough grind to approximate size by swinging across face of wheel as with the diamond dresser above, and like Fig. 3. Do not rotate the cutter while rough grinding the bulk of stock, as it will burn more easily. After roughing, the cone should consist of a series of flats like Fig. 3. Now continue as above, but rotating the cutter also, to produce a smooth finish, free as possible from wheel marks.



Fig. 3—Before and After Roughing

Grinding Clearance

The cutter is now the correct angle, with a cutting edge, but it has no chip clearance. This should be approximately 5 degrees on back side of cutting edge (the exact angle of cutter and proper clearance will be determined by the various classes of work, see pages 25 and 27). For example, set tool head at 30 degrees and grind conical point, then reset tool head at 25 degrees for clearance. Feed cutter with back side (round side) against grinding wheel and grind a flat as close to cutting edge as possible, but *be careful not to disturb cutting edge*. Do not rotate cutter when grinding this flat. Now revolve cutter by turning cutter back and forth, and at the same time swinging across face of wheel just as when grinding the conical point, but being careful not to revolve cutter too far against grinding wheel and so disturb the cutting edge. An enlarged view of the cutter point should now appear like Fig. 5, and a cross section like Fig. 6. Note that the cutters should rotate in a clock-wise direction when viewed from above.

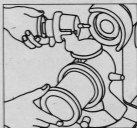


Fig. 4—Grinding with 375-1



Fig. 5—Cutting Edge and Clearance

Grinding Flat Side to Center—Tipping Off, Etc.

Most Gorton single lip cutters have a flat side ground to exact center, but in some cases this is a trifle full, for additional strength, as indicated by dotted line in Fig. 7. After proceeding as above, examine the conical point with a magnifying glass to see if flat and point coincide. If not, grind the flat back until it does, taking especial care to get it square with original surface.

(Continued page 24)

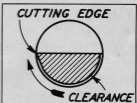


Fig. 6 — Section Through Fig. 5 on Dotted Line

GRINDING CUTTERS WITH GORTON CUTTER GRINDERS

Continued

It will often be found desirable to use a cutter with a blunted point or "tipped off," particularly on work requiring severe service where the very point could easily be broken off. This is done by hand, holding the cutter against the face of wheel and grinding at an angle back from the cutting edge, which is always the high point. See Fig. 7. This tip should also be sloped back from the flat as shown. When straight-sided single lip cutters are ground, they are always tipped off in this manner as Fig. 8, unless all the cutting will be done with the side of cutter, in which case the end will not matter. Cutters tipped off in this way enable them to penetrate like a drill when first fed into the work to begin cutting a line.

3 and 4 Sided Cutters

Sometimes it is desired to grind cutters with 3 or 4 sides like Fig. 9, and in such cutters no clearance or flat, etc., is required. Such cutters are indexed for the desired number of sides by using the index dial and plunger of grinder tool head. This type of cutter is used for very light engraving, and will produce a smoother finish than the single lip cutters.

GRINDING CUTTERS WITH ATTACHMENT 288-1 ON PANTOGRAPH MACHINES

(As shown on page 11, Accessories Catalog)

First: Insert Pantograph style into hole in copy holder. This holds cutter head rigid.

If cutter head is equipped with depth gauge, loosen foot nut and swing foot outward. Now insert grinding wheel and bolt cutter holder base in place, with cutter point at inside edge of wheel, all as photo at lower right.

Remove cutter holder by lifting spring slightly and insert cutter tightly, using small wrench.

Replace cutter holder and grind cutter point to the proper angle by revolving cutter and shifting table with cross slides.

With cutter pointed as desired, it must be ground for clearance, as shown on Fig. 5, page 23, which means grinding away the metal back of cutting edge so that cutter will cut free and raise no burr on work. To grind this clearance, table must be shifted slightly so that wheel will grind above the cutter point.

By rotating cutter (half turn) back and forth, clearance can be ground without actually grinding the point and cutting edge more than just enough to bring it to a sharp edge. Remove point slightly with a fine oilstone.

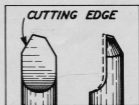


Fig. 7—A "Tipped Off" Cutter



Fig. 8—Straight Side Cutter

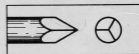


Fig. 9—3-Sided Cutter



Grinding Cutter with Attachment 288-1

GRINDING CUTTERS—Continued . OPERATION OF CUTTERS

Recommended Angles and Clearances

Single lip, conical point cutters, as illustrated on pages 23 and 24, are usually ground to about 30 degrees (60 degrees included angle) for general engraving, with a clearance of five degrees. This clearance will not vary more than two or three degrees, regardless of the material to be cut or angle of conical point. However, with soft materials the clearance may be greater, and with hard materials, less. See page 27 for recommended cutter angles on steel stamps.

Grinding Very Fine Cutter Points

Most of the difficulties experienced when using extremely small cutters on small lettering in dies and stamps are caused by improper grinding. This applies especially to the *very cutter point* where possibly only .01" of the point is used.

This *very point*, therefore, is the part that *must* be accurately sharpened. If the actual *point* is not perfect, a cutter that may be beautifully ground in all other respects is simply no good for doing the work. Examine the point with a good magnifying glass, and do not try to use the cutter until you are satisfied that it is in perfect condition for doing the kind of work you have a right to expect of it. When trouble is experienced, usually the point is *burned*, or the flat is either *too high* or *too low*. Perhaps the clearance does not run clear out to the *point*. Sometimes stoning off the flat with a small fine oil stone will make the cutting edge keener.



Grinding Cutters on 375-1
Cutter Grinder

For small, fine sunk letters 1/32" to 1/16" high and say, .005" to .015" depth of cut, grind the cutter in place in the spindle of the machine to an angle of about 25 degrees. Trace the copy *evenly* and *steadily* as a sudden jerk will be almost certain to break off the cutter point. A correctly ground cutter should engrave from 30 to 50 characters this size in annealed tool steel before resharpening.

Operation of Cutters—General
After the cutter has been placed in operation, it must be kept sharp and with proper clearance

at all times. This is particularly important when running at extremely high speeds as a dull cutter burns quickly. If the cutter raises a burr, it is pretty certain to be dull or without clearance, or both. Cutters will not always cut the same kind of material with equal facility as materials vary in density and hardness, even in the same piece. A dirty or worn collet may cause a cutter to run out of true. Loose or badly worn spindle bearings will frequently cause the cutter to break. Wring the cutter (if taper shank) in the spindle very tight. Do not continue with a cutter if it comes loose, or the spindle will be worn so that no cutter can be held properly. If this happens, check taper of cutter in spindle by rubbing on a little Prussian blue. The cutter should fit more tightly at small end than large. If the blue shows otherwise, and the spindle is old, it is probably worn out of true and needs replacing.



Typical Cutter Shapes

APPROXIMATE CUTTER SPEED CHART

Revolutions per minute for High Speed Steel Cutters, single or two lip type.

Use two-thirds of speeds shown for 4 and 6 flute end mills.

Cutter Diameter (at cutting point)	1/32"	1/16"	1/8"	3/16"	1/4"	5/16"	3/8"	7/16"	1/2"
Hard Wood	10,000 to 20,000	Ditto	Ditto	Ditto	Ditto	Ditto	8,000	8,000	8,000
*Bakelite	10,000	8,000	6,000	4,000	2,000	1,250	1,000	800	700
†Engraver's Brass	10,000	10,000	10,000	10,000	10,000	8,000	8,000	6,000	6,000
Aluminum	to 15,000	to 15,000	to 15,000						
Cast Iron	8,000	7,500	6,000	5,200	4,500	4,000	3,500	2,000	1,200
Hard Bronze									
Machine Steel	6,500	6,000	3,000	2,200	1,600	1,200	975	800	700
Annealed Tool Steel ..	5,000	4,500	2,300	1,600	1,200	1,000	850	725	600
Stainless, Monel, Etc...	3,500	2,750	1,400	1,050	700	610	525	435	350
Very Hard Die and Alloy Steels	2,000	1,250	800	600	475	400	350	300	250

*Also celluloid, hard rubber, pearl, ivory and synthetic plastics.

Tungsten or Tantalum carbide cutters can be run at much higher speeds on these materials than given in table.

†Also ordinary brass, zinc, copper, silver, gold, soft bronze, German silver.

Diamond cutters—same speeds for all materials as for cutting in brass with steel cutters.

The accompanying chart gives an idea of correct cutter speeds for different cutters and materials. These speeds, however, will vary greatly, depending on the depth of cut and the rate at which cutter is fed through the work.

Roughing Cuts

For a heavy roughing cut, where considerable stock is removed, it may be necessary to use slower speeds than chart, while for finishing where only a few thousandths of an inch are removed, higher speeds can be used. For heavy roughing cuts much depends on the rate at which the cutter is fed through the work. For any given depth of cut the speed must be decreased as the depth of cut is increased.

Speeds and Feeds

Practically all Gorton machines are manually op-

erated, and with a little experience, the operator can feel with the Pantograph when the cutter is working at maximum efficiency. With all Pantograph machines it is best to run cutters at highest speeds possible, and remove stock with several light fast cuts, rather than one heavy cut at slower spindle speeds. Always use the highest speed possible without burning the cutter. In cutting steel, start at a slow speed and work up to the fastest which cutter will stand without loosing its cutting edge.

This chart and instructions are intended only as a guide for the inexperienced operator, or persons not familiar with the operation of small high speed cutters such as used in Gorton machines. The experienced operator will have found by trial the speeds and feeds best suited to his own work, and for such this chart is only for comparison.

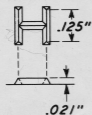
CUTTING STEEL DIES AND STAMPS

Die Steel

A high grade of well annealed tool steel should be used. Very tough steels may be necessary on some stamps intended for severe service, but for most work a freer cutting steel will be just as serviceable and much easier to cut. The time and trouble saved in cutting more than makes up for the higher cost of a good steel. Use enough lubricant to avoid burning the cutters. Single lip cutters cut freest but 3 or 4 sided cutters are sometimes useful for finishing as they leave a smooth finish.

Proportions of Steel Stamp Letters

A practical way to proportion steel stamps is to make the raised height of stamp about 1/6 of the height of the characters (on the center line). For instance, if the letter is .125" printed height, then the raised height of stamp would be .021". (See diagram.)



For roughing always use the largest diameter tracing style possible. If your tracing style is too large to pass through some portions of the copy, that will make no difference. Raise cutter out of work and pass the style to the next portion of copy where it will trace

through, etc. Three sizes of cutters are generally used, the last one for removing only 3 or 4 thousandths of stock. Eighty percent of material is removed with the first cut.

Corners of Letters

Corners can be removed by "stepping up." Set the cutter at half depth when stamp is otherwise finished, and use a tracing style as small as possible without under-cutting.

Recommended Angles for Relief Characters

The taper desired on relief characters will determine the angle to which the cutter is ground. On

stamps designed for hard use, such as large, heavy steel stamps, the characters should be cut with a cutter having an angle of 37 to 45 degrees (on a side) on the cutting edge. For light steel stamps, to be used on brass, copper, lead and other soft materials, 25 to 35 degrees will be found strong enough. For stamps to be used on wood, 10 or 15 degrees on the cutting edge is sufficient.

Determining Cutter Angles for Sunk Characters

It may frequently be necessary to engrave sunk characters to a predetermined width of face. To find this, when the angle of cutter is known, simply multiply by the proper tangent, then multiply the result by two (2). Below is a table of tangents. (More complete tables can be found in any Machinist Hand Book.)

15	degrees =	.267
17	"	.305
20	"	.364
22.5	"	.414
25	"	.466
30	"	.577
33	"	.649
35	"	.700
37.5	"	.767
40	"	.839
42.5	"	.916
45	"	1.000

Example: If a 60 degree included angle cutter is being used and depth of cut is .012", multiply the tangent of 30 degrees (.577) by the depth, which will equal .0069". Multiply this by two which will equal .0138", or the face of cut. If the cutter is to be used with the point "tipped off", proceed as above and add the diameter of the cutter tip.

NOTE: The width of face in all cases above is taken at surface of work.

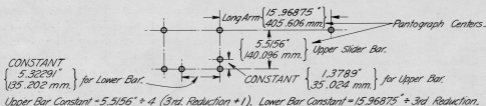
FORMULA FOR OBTAINING SPECIAL REDUCTIONS

FORM
990-A

ON ENGRAVING MACHINES, NUMBERS $\left\{ \begin{array}{l} 1A, 1G, 1H, \\ 3A, 3G, 3H, 3F, 3X. \end{array} \right.$

LEAST REDUCTION POSSIBLE 3 TO 1. GREATEST REDUCTION POSSIBLE 100 TO 1.

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RACINE, WIS., U. S. A.



EXAMPLE: REQUIRED THE SETTINGS IN INCHES FOR REDUCING 5.3 TO 1.

For LOWER Slider Bar

Required Reduction 5.3 \rightarrow 15.96875" \rightarrow 3.0129" \rightarrow Lower Bar Constant 5.3229" \rightarrow 2.3100"

Long Arm Centers:

68
53
157
106
515
477
38

Subtract from

Distance to set Index Edge on Lower Slider Bar Head from Graduation 3. See below sketch.

For UPPER Slider Bar

First divide the Upper Slider Bar Center distance 5.5156" by the Reduction Required plus a Constant of 1.

Reduction Required 5.3 \rightarrow 6.3 \rightarrow 1.0 \rightarrow Upper Bar Constant 1.3789" \rightarrow 0.8754"

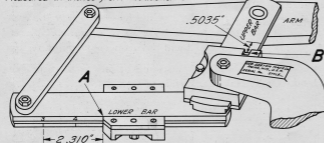
Upper Slider Bar Centers:

5.51560"
5.04
475
441
346
315
310
252
58

Subtract from

Distance to set Index Edge on Upper Slider Bar Head from Graduation 3. See below sketch.

PANTOGRAPH SET TO THE 5.3 REDUCTION



To set the Pantograph for any desired Special Scale of Reduction as per above Formula or as per Schedule of various Reductions given: Place the Bevelled Index Edges of the Sliders away from the Lines marked 3 on the Bars, the Distances required. THUS. As shown in the Sketch for the Reduction 5.3 the Lower Bar Slider must be set as at 'A' 2.310" from the Line 3, and the Upper Bar Slider as at 'B' .5035" from its Line 3.

REDUCTION SCHEDULES in INCHES and MILLIMETERS

FORM
993-A

SCHEDULE OF REDUCTIONS
FOR ENGRAVING MACHINES NOS.
**1C,
3C,
SPECIAL PANTOGRAPH,
TOOL NUMBER
55-1.**

REDUCTION	LOWER BAR INCHES	UPPER BAR INCHES
1.0	0.000	0.000
1.1	0.544	0.131
1.2	0.927	0.251
1.3	1.301	0.360
1.4	1.710	0.460
1.5	1.973	0.552
1.6	2.244	0.636
1.7	2.464	0.715
1.8	2.660	0.780
1.9	2.835	0.854
2.0	2.992	0.919
2.1	3.133	0.979
2.2	3.265	1.034
2.3	3.391	1.086
2.4	3.511	1.136
2.5	3.591	1.182
2.6	3.663	1.225
2.7	3.730	1.269
2.8	3.847	1.306
2.9	3.921	1.344
3.0	3.990	1.379

FORM
994-A

SCHEDULE OF REDUCTIONS
FOR ENGRAVING MACHINES NOS.
**1C,
3C,
SPECIAL PANTOGRAPH,
TOOL NUMBER
55-1.**

REDUCTION	LOWER BAR MILLIMETERS	UPPER BAR MILLIMETERS
1.0	0.000	0.00
1.1	13.62	3.34
1.2	23.84	6.37
1.3	33.08	9.14
1.4	43.43	11.67
1.5	52.87	14.01
1.6	57.01	16.16
1.7	62.60	18.16
1.8	67.88	20.01
1.9	74.01	21.74
2.0	76.01	23.35
2.1	78.63	24.86
2.2	82.92	26.27
2.3	85.92	27.59
2.4	88.66	28.84
2.5	91.91	30.02
2.6	95.35	31.13
2.7	97.92	32.08
2.8	97.73	33.16
2.9	97.42	34.13
3.0	101.55	35.02

FORM
947-A

SCHEDULE OF REDUCTIONS
FOR ENGRAVING MACHINES NOS.
**1A, 1G, 1H,
3A, 3G, 3H, 3F, 3X.**

REDUCTION	LOWER BAR MILLIMETERS	UPPER BAR MILLIMETERS
3.0	0.00	0.00
3.1	4.36	0.83
3.2	8.45	1.67
3.3	12.29	2.44
3.4	15.91	3.18
3.5	19.31	3.89
3.6	22.53	4.57
3.7	25.58	5.22
3.8	28.46	5.84
3.9	31.10	6.43
4.0	33.60	7.00
4.1	36.27	7.55
4.2	38.63	8.08
4.3	40.88	8.59
4.4	43.02	9.08
4.5	45.07	9.55
4.6	47.03	10.01
4.7	48.60	10.43
4.8	50.70	10.87
4.9	52.43	11.28
5.0	54.08	11.67
5.1	55.57	12.06
5.2	57.20	12.43
5.3	58.67	12.79
5.4	60.09	13.13
5.5	61.46	13.47
5.6	62.77	13.80
5.7	64.04	14.11
5.8	65.27	14.42
5.9	66.46	14.72
6.0	67.60	15.01
6.1	68.71	15.29
6.2	69.78	15.57
6.3	70.82	15.83
6.4	71.83	16.09
6.5	72.80	16.34
6.6	73.75	16.59
6.7	74.66	16.83
6.8	75.55	17.06
6.9	76.42	17.29
7.0	77.26	17.51
7.2	78.87	17.94
7.4	80.39	18.33
7.6	81.83	18.73
7.8	83.20	19.10
8.0	84.50	19.46
8.2	85.74	19.80
8.4	86.92	20.12
8.6	88.04	20.43
8.8	89.11	20.73
9.00	90.13	21.01
9.18	91.13	21.31
9.30	92.11	21.60
9.75	93.60	21.99
10.00	94.64	22.29
10.30	95.87	22.84
11.00	98.33	23.33
11.30	97.23	23.82
12.00	101.40	24.25
12.30	102.75	24.65
13.00	104.00	25.02
14.00	106.23	25.68
15.00	108.16	26.27
16.00	109.85	26.78
18.00	112.67	27.65
20.00	114.92	28.35
22.00	116.77	28.93
24.00	118.30	29.42
26.00	119.60	29.84
28.00	120.72	30.19
30.00	121.68	30.50

FORM
948-A

SCHEDULE OF REDUCTIONS
FOR ENGRAVING MACHINES NOS.
**1A, 1G, 1H,
3A, 3G, 3H, 3F, 3X.**

REDUCTION	LOWER BAR INCHES	UPPER BAR INCHES
3.0	0.000	0.000
3.1	0.172	0.034
3.2	0.333	0.066
3.3	0.486	0.096
3.4	0.626	0.126
3.5	0.766	0.153
3.6	0.897	0.180
3.7	1.007	0.205
3.8	1.121	0.230
3.9	1.228	0.253
4.0	1.331	0.276
4.1	1.428	0.297
4.2	1.521	0.318
4.3	1.609	0.339
4.4	1.694	0.357
4.5	1.774	0.376
4.6	1.851	0.394
4.7	1.926	0.411
4.8	1.996	0.428
4.9	2.064	0.444
5.0	2.129	0.460
5.1	2.192	0.475
5.2	2.252	0.489
5.3	2.310	0.503
5.4	2.366	0.516
5.5	2.419	0.530
5.6	2.471	0.543
5.7	2.521	0.556
5.8	2.570	0.568
5.9	2.616	0.580
6.0	2.661	0.591
6.1	2.705	0.602
6.2	2.748	0.613
6.3	2.790	0.623
6.4	2.831	0.634
6.5	2.871	0.644
6.6	2.903	0.653
6.7	2.933	0.662
6.8	2.972	0.672
6.9	3.009	0.681
7.0	3.042	0.689
7.2	3.108	0.706
7.4	3.163	0.722
7.6	3.222	0.738
7.8	3.276	0.752
8.0	3.327	0.766
8.2	3.375	0.779
8.4	3.422	0.792
8.6	3.466	0.804
8.8	3.508	0.816
9.00	3.549	0.827
9.18	3.587	0.831
9.30	3.622	0.834
9.75	3.685	0.866
10.00	3.726	0.877
10.30	3.802	0.899
11.00	3.871	0.919
11.30	3.934	0.938
12.00	3.992	0.953
12.30	4.043	0.970
13.00	4.095	0.985
14.00	4.182	1.011
15.00	4.258	1.034
16.00	4.323	1.054
18.00	4.436	1.089
20.00	4.524	1.116
22.00	4.597	1.139
24.00	4.655	1.158
26.00	4.709	1.175
28.00	4.753	1.189
30.00	4.791	1.201

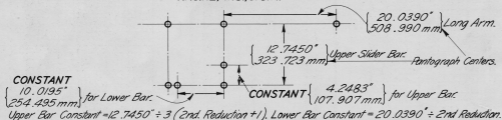
FORMULA FOR OBTAINING SPECIAL REDUCTIONS **FORM 987-A**

ON ENGRAVING MACHINES, NUMBERS { 1D, 1J.
3D, 3J, 3U, 3Z.

LEAST REDUCTION POSSIBLE
1D, 1J, 3D, 3J = 2 TO 1.
3U, 3Z = 1 TO 1.

GREATEST REDUCTION POSSIBLE
1D, 1J, 3D, 3J, 3Z = 16 TO 1.
3U = 40 TO 1.

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RACINE, WIS., U.S.A.



EXAMPLE: REQUIRED THE SETTINGS IN MILLIMETERS FOR REDUCING 4 TO 1.

For LOWER Slider Bar

Required Reduction 4.0) 508.990 mm. Lower Bar Constant 254.495 mm.
127.247 mm. Subtract from 127.248 mm.

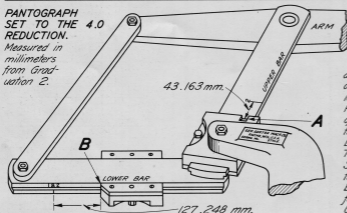
Distance to set Index Edge on Lower Slider Bar Head from Graduation 2. See below sketch.

For UPPER Slider Bar

First divide the Upper Slider Bar Center distance 323.723 mm. by the Reduction Required plus a constant of 1.
1.0 Upper Slider Bar Centers.
Reduction Required 4.0) 323.723 mm.
5.0) 64.744 mm.

Subtract from 107.907 mm. Upper Bar Constant 64.744 mm.
Distance 43.163 mm. to set Index Edge on Upper Slider Bar Head from Graduation 2. See below sketch.

PANTOGRAPH SET TO THE REDUCTION. 4.0
Measured in millimeters from Graduation 2.



To set the Pantograph for any desired Special Scale of Reduction as per above formula or as per Schedule of various Reductions given: Place the Bevelled Index Edges of the Sliders away from the Lines marked 2 on the Bars, the Distances required: **THUS**—As shown in the Sketch for the Reduction 4.0 the Lower Slider Block must be set as at B, 127.248 mm. from the Line 2 and the Upper Slider Block as at A 43.163 mm. from its Line 2.

REDUCTION SCHEDULES in INCHES and MILLIMETERS

FORM 988-A SCHEDULE OF REDUCTIONS FOR ENGRAVING MACHINES NOS. 1D, 1J. 3D, 3J, 3U, 3Z.		
REDUCTION	LOWER BAR INCHES	UPPER BAR INCHES
2.0	0.000	0.000
2.1	0.477	0.137
2.2	0.911	0.263
2.3	1.307	0.356
2.4	1.670	0.400
2.5	2.004	0.507
2.6	2.312	0.706
2.7	2.590	0.804
2.8	2.853	0.154
2.9	3.109	0.900
3.0	3.340	1.062
3.1	3.553	1.140
3.2	3.757	1.214
3.3	3.947	1.284
3.4	4.124	1.353
3.5	4.294	1.416
3.6	4.453	1.470
3.7	4.604	1.523
3.8	4.746	1.575
3.9	4.881	1.627
4.0	5.010	1.679
4.1	5.132	1.729
4.2	5.248	1.777
4.3	5.359	1.824
4.4	5.465	1.868
4.5	5.566	1.911
4.6	5.663	1.952
4.7	5.756	2.000
4.8	5.845	2.031
4.9	5.930	2.068
5.0	6.012	2.124
5.1	6.090	2.159
5.2	6.165	2.193
5.3	6.239	2.225
5.4	6.309	2.257
5.5	6.376	2.288
5.6	6.441	2.317
5.7	6.504	2.346
5.8	6.564	2.374
5.9	6.623	2.401
6.0	6.680	2.428
6.1	6.734	2.453
6.2	6.787	2.478
6.3	6.839	2.502
6.4	6.890	2.526
6.5	6.939	2.549
6.6	6.983	2.571
6.7	7.029	2.593
6.8	7.073	2.616
6.9	7.115	2.633
7.0	7.157	2.655
7.1	7.197	2.673
7.2	7.236	2.694
7.3	7.274	2.713
7.4	7.312	2.731
7.5	7.348	2.749
7.6	7.383	2.766
7.7	7.417	2.783
7.8	7.450	2.800
7.9	7.483	2.816
8.0	7.515	2.832
9.0	7.793	2.974
10.0	8.016	3.090
11.0	8.198	3.186
12.0	8.350	3.266
13.00	8.478	3.338
14.00	8.588	3.399
15.00	8.683	3.452
16.00	8.767	3.499

NOTE—
Only 3-U, 3-Z
machines will
operate between
reduc-
tions 1 and 2.

For reductions
from 1 to 2,
see chart 7561.

FORM 989-A SCHEDULE OF REDUCTIONS FOR ENGRAVING MACHINES NOS. 1D, 1J. 3D, 3J, 3U, 3Z.		
REDUCTION	LOWER BAR MILLIMETERS	UPPER BAR MILLIMETERS
2.0	00.00	0.00
2.1	12.12	3.48
2.2	23.14	6.74
2.3	33.19	9.61
2.4	42.42	12.60
2.5	50.90	15.47
2.6	58.73	17.93
2.7	65.98	20.41
2.8	72.71	22.92
2.9	78.98	24.90
3.0	84.83	26.98
3.1	90.30	28.95
3.2	95.44	30.83
3.3	100.26	32.62
3.4	104.79	34.33
3.5	109.07	35.97
3.6	113.11	37.53
3.7	116.93	39.03
3.8	120.55	40.46
3.9	123.98	41.84
4.0	127.25	43.16
4.1	130.35	44.43
4.2	133.31	45.67
4.3	136.14	46.83
4.4	138.82	47.95
4.5	141.39	49.05
4.6	143.84	50.10
4.7	146.20	51.11
4.8	148.46	52.09
4.9	150.62	53.04
5.0	152.70	53.95
5.1	154.69	54.83
5.2	156.61	55.69
5.3	158.46	56.52
5.4	160.24	57.33
5.5	161.95	58.10
5.6	163.60	58.86
5.7	165.20	59.59
5.8	166.74	60.30
5.9	168.23	60.99
6.0	169.66	61.66
6.1	171.05	62.31
6.2	172.40	62.95
6.3	173.70	63.56
6.4	174.97	64.16
6.5	176.19	64.74
6.6	177.36	65.31
6.7	178.50	65.87
6.8	179.60	66.40
6.9	180.73	66.93
7.0	181.78	67.44
7.1	182.81	67.94
7.2	183.80	68.43
7.3	184.77	68.90
7.4	185.71	69.37
7.5	186.63	69.82
7.6	187.52	70.26
7.7	188.39	70.70
7.8	189.24	71.12
7.9	190.07	71.53
8.0	190.87	71.94
9.0	197.94	75.53
10.0	203.60	78.48
11.0	208.22	80.93
12.0	212.08	83.01
13.0	215.34	84.78
14.0	218.13	86.32
15.0	220.56	87.67
16.0	222.68	88.86

MACHINES for DIE, MOLD and TOOL MAKING



Milling slot in drop-forged die with 8-D Universal



Grinding Cutters on 375-1 Universal Cutter Grinder



Graduating machine 687-1 for small discs, cylinders and dials

A complete line of precision, high speed spindle machines in 30 styles and sizes effect tremendous savings in the production of plastic, rubber, and glass molds, die-casting dies, stamps and roll dies, rolls, small accurate tool and production work, high speed profiling and in the engraving of lettering and designs in any material.

PANTOGRAPH MACHINES

In standard sizes from 50 pounds to 5 tons, including Tire Mold, Roll Cutting and Matrix Type-Cutting Machines. Also used as profilers for high production with small cutters of shapes, cams, grooves and reliefs in cast iron, aluminum, brass, bronze, bakelite, etc., with special work-holders if required.

VERTICAL MILLING MACHINES

For tool, die and mold work. With high speed precision spindles, in a wide range of sizes. Exclusive patented features provide increased capacity and range, higher accuracy and speed of operation.

UNIVERSAL MILLING MACHINES

For tool, die, mold and metal pattern work. Spindle heads fully universal in all directions. High spindle speeds, and all the exclusive features incorporated in Gorton Verticals.

DUPLICATING MACHINES

Cut duplicate dies, molds, punches and inserts for plastic, rubber and glass molds and die-casting dies. Made in several sizes, manually operated, with high speed spindles. Extremely accurate, for precision work.

ROUTING MACHINES

Specially designed for brass routing and general engraving, with spindle speeds to 15,000 R.P.M., foot treadle, chip blower, etc.

GRADUATING MACHINES

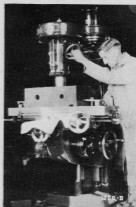
For graduating on flat or angular faces, or periphery of discs, cylinders and dials.

UNIVERSAL CUTTER GRINDERS

Grind to any angle with clearance, small die-sinking, routing and engraving cutters, angle and end mills of steel or new hard alloys. Also equipped for diamond lapping.

TOOLS AND CUTTERS

Circular and Universal Tables, Plain and Universal Vises and Holders, Collets, Special Tools and Fixtures; Carbon, High Speed Steel and Hard Alloy End Mills and Cutters in small sizes.



Milling cavity in core box with 9-J Vertical



Duplicating punch for Bakelite mold with 8-D Duplicator



WHEREVER SMALL CUTTERS RUN AT HIGH SPEEDS
"CALL ON GORTON"—LET GORTON ENGINEERS APPLY THEIR
SPECIALIZED KNOWLEDGE TO THE SOLUTION OF YOUR PROBLEMS

SINCE 1893...
The Mark of **FINE**
MACHINE TOOLS

*This line extends $\frac{3}{4}$ " further
on this side & $\frac{1}{2}$ " on top side*

1st Reduction

This line is parallel with

**AREA CHART FOR GORTON (STANDARD TYPE)
PANTOGRAPH MACHINE No. 3-U.**

*Showing the largest
area covered with
cutter point on the
various reductions
without resetting
work or copy.*

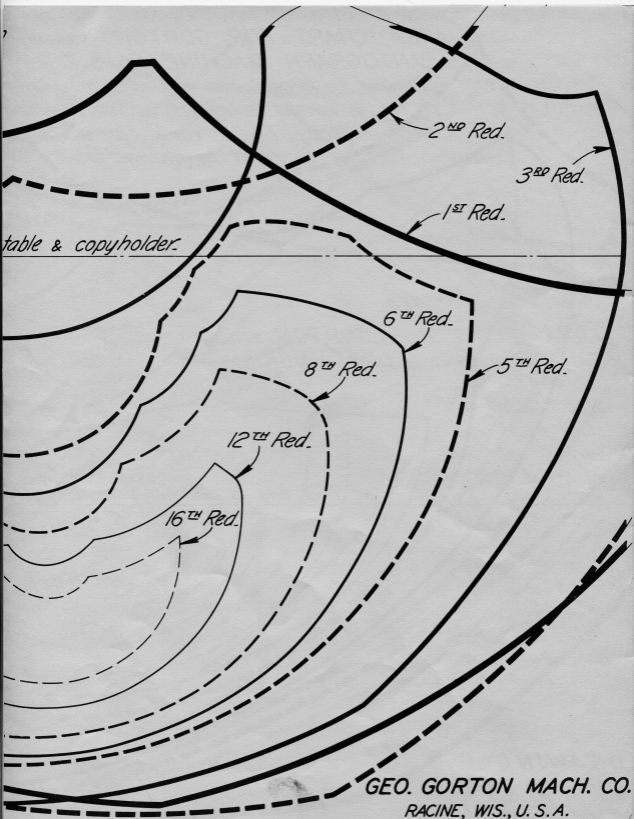
*Larger work
can of course
be reset by
moving
table.*

*All
these lines
extend 2"
further on both ends.*

DRAWING

9353

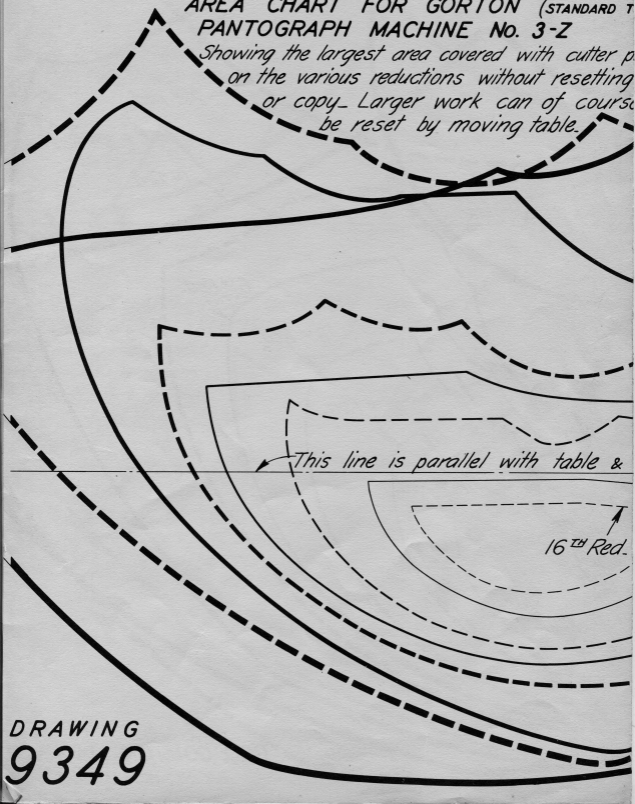
table & copyholder.



GEO. GORTON MACH. CO.
RACINE, WIS., U. S. A.

AREA CHART FOR GORTON (STANDARD T
PANTOGRAPH MACHINE No. 3-Z

*Showing the largest area covered with cutter p
on the various reductions without resetting
or copy. Larger work can of course
be reset by moving table.*



DRAWING
9349

TYPE)

oint
work

copyholder

3RD Red.

5TH Red.

2ND Red.

1ST Red.

6TH Red.

8TH Red.

12TH Red.

This line extends
 $1\frac{1}{2}$ " further on the
left side and $\frac{1}{2}$ "
on the right side.

This line extends 2"
further on both sides.

GEO. GORTON MACH. CO.
RACINE, WIS., U.S.A.

AREA CHART FOR 3-S DIE CUTTING AND PROFILING MACHINE - (STANDARD TYPE)

Showing the largest area covered with cutter
point on the various reductions
without resetting work or copy.

Work can of course
be set by moving
table.

FORMULA

For obtaining any intermediate reduction
not given on pantograph scales.

EXAMPLE 3.5 (Reduction required)

$$\begin{array}{r} \text{CONSTANT } 3.5 \\ \rightarrow + 1.0 \\ \hline 4.5 \end{array}$$

$$\begin{array}{r} \text{CONSTANT} \rightarrow 24. \\ \hline 4.5 = 5.333 \end{array}$$

$$\begin{array}{r} \text{CONSTANT } 5.333 \\ \rightarrow - 3.000 \\ \hline 2.333 \text{ Inches} \end{array}$$

NOTE

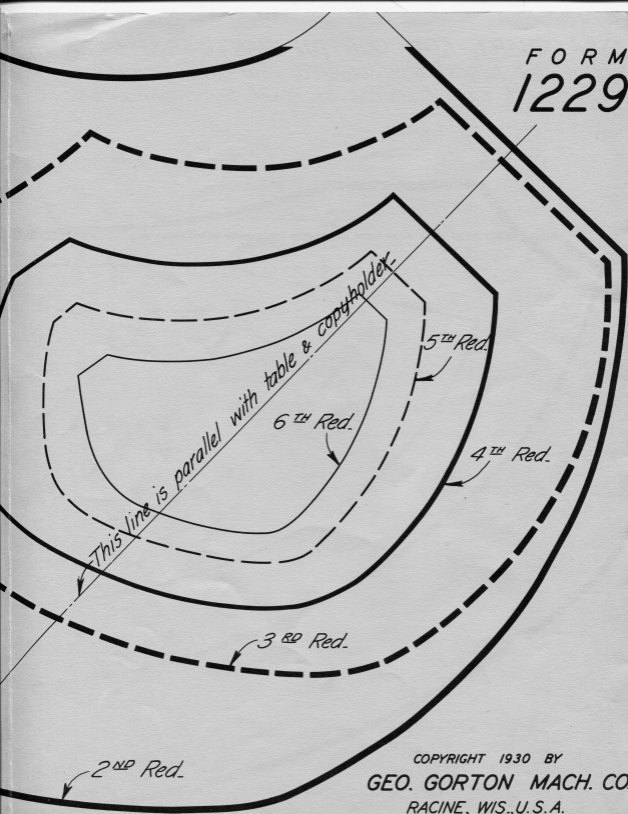
The one to one
pantograph setting
is too large to show
hereon. Blue-print 6499

of same will be sent on re-
quest. On the one to one setting, the
following areas can be covered at one
setting of work & copy:

14" x 9 $\frac{3}{4}$ " - 18" x 8 $\frac{3}{8}$ " - 21" x 4" - 23" x 2 $\frac{1}{2}$ "

Set all three
Pantograph scales to this
reading for 3.5 reduction.

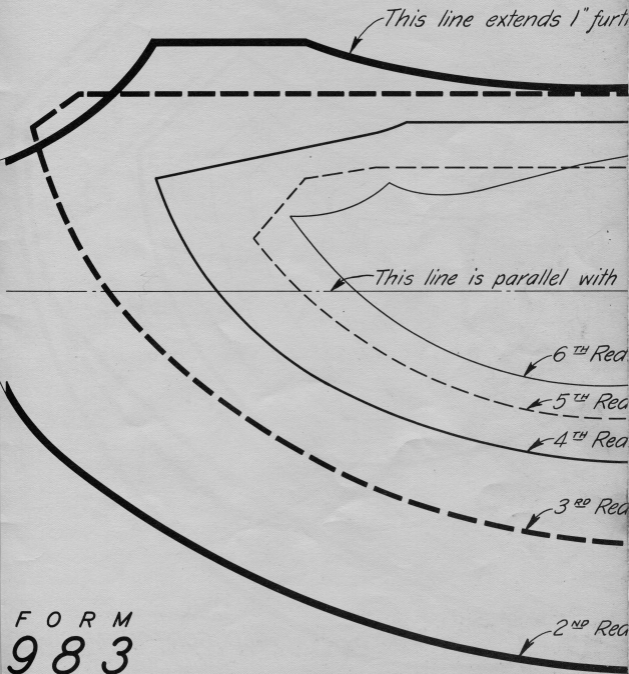
FORM
1229



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RACINE, WIS., U.S.A.

AREA CHART FOR GORTON PANTOGRAPH MACHIN

Showing the largest area covered with cutter point on the var
Larger work can of course be reset by moving table.



FORM
983

ES, (STANDARD TYPE) NO'S. 1-D, 1-J, 3-D, 3-J. (NOW OBSOLETE)
ious reductions without resetting work or copy.

her on both sides.

table & copyholder.

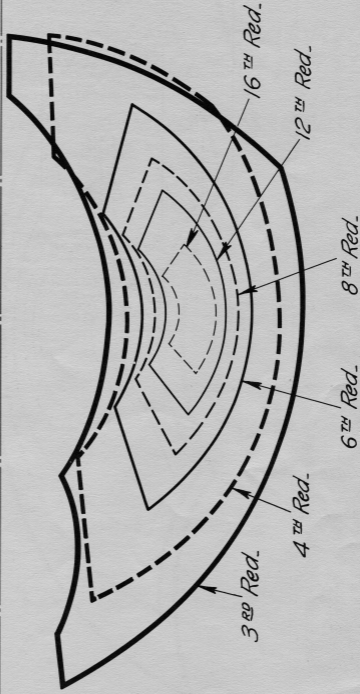
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GEO. GORTON MACH. CO.
RACINE, WIS., U. S. A.

AREA CHART FOR GORTON PANTOGRAPH MACHINES.

(STANDARD TYPE) No's. 1-A, 1-G, 1-H, 3-A, 3-G, 3-H. (NOW OBSOLETE)

Showing the largest area covered with cutter point on the various reductions without resetting work or copy. Larger work can of course be reset by moving table.

← This line is parallel with table & copyholder.



FORM
949

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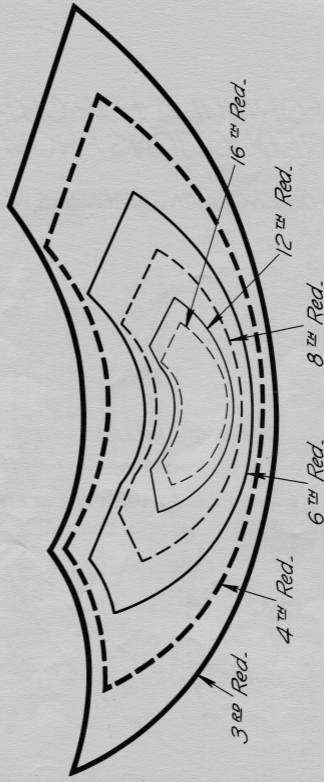
RACINE, WIS., U. S. A.

AREA CHART FOR GORTON PANTOGRAPH MACHINES.

(STANDARD TYPE) NO'S. 3-F, 3-X.

Showing the largest area covered with cutter point on the various reductions without resetting work or copy. Larger work can of course be reset by moving table.

→ This line is parallel with table & copyholder.

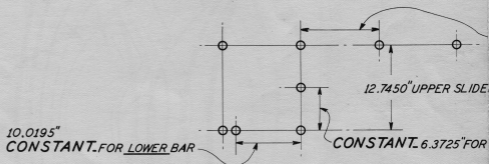


DRAWING
9358

GEO. GORTON MACH. CO.
RACINE, WIS., U. S. A.

FORMULA FOR OBTAINING SPEC REDUCTIONS FROM 1 TO 1, TO 2 7

ON ENGRAVING MACHINES, NUMBERS 3U, 3Z.



EXAMPLE: REQUIRED THE SETTINGS IN INCHES FOR RED

FOR LOWER SLIDER BAR.

REQUIRED REDUCTION 1.5) $\frac{10.0195''}{6.679}$

LONG ARM CENTERS.

SUBTRACT FROM $\frac{10.0195''}{6.679''}$

$3.340''$

DISTANCE TO SET INDEX EDGE ON LOWER
SLIDER BAR HEAD FROM GRADUATION 1 & 2.

FOR UP

FIRST DIVIDE THE UPPER
DISTANCE 12.745" BY 7
REQUIRED PLUS A CON
REDUCTION 1.5) $\frac{12.745}{2.5}$

SUBTRACT FROM $\rightarrow 6$

DISTANCE $\rightarrow 1$

TO SET INDEX EDGE
HEAD FROM GRADUAT

SCHEDULE OF VARIOUS REDUCTIONS
BETWEEN 1 TO 1 & 2 TO 1, ON NOS.
3U & 3Z MACHINES—
WITH TRACING STYLE IN NEAREST
HOLE OF PANTOGRAPH ARM.

DISTANCES GIVEN IN INCHES.

REDUCTION	DISTANCE NECESSARY TO SET INDEX EDGE ON LOWER SLIDER BAR HEAD FROM GRAD- UATION MARKED 1 & 2.	DISTANCE NECESSARY TO SET INDEX EDGE ON UPPER SLIDER BAR HEAD FROM GRAD- UATION MARKED 1.
1.0	0	0
1.1	.911"	.303"
1.2	1.670"	.579"
1.3	2.312"	.831"
1.4	2.863"	1.062"
1.5	3.340"	1.275"
1.6	3.757"	1.471"
1.7	4.126"	1.651"
1.8	4.453"	1.821"
1.9	4.746"	1.978"

TO OBTAIN ANY SPECIAL REDUCTION
NOT GIVEN ABOVE, USE FORMULA.

FOR GREATER REDUCTIONS USE
SCHEDULE AS PER INSTRUCTION
BOOK WITH TRACING STYLE AT
EXTREME END OF PANTOGRAPH ARM.

IAL
TO 1.

10.0195" LONG ARM.

R BAR.
PANTOGRAPH CENTERS.

UPPER BAR.

UCING 1.5 TO 1.

PER SLIDER BAR.

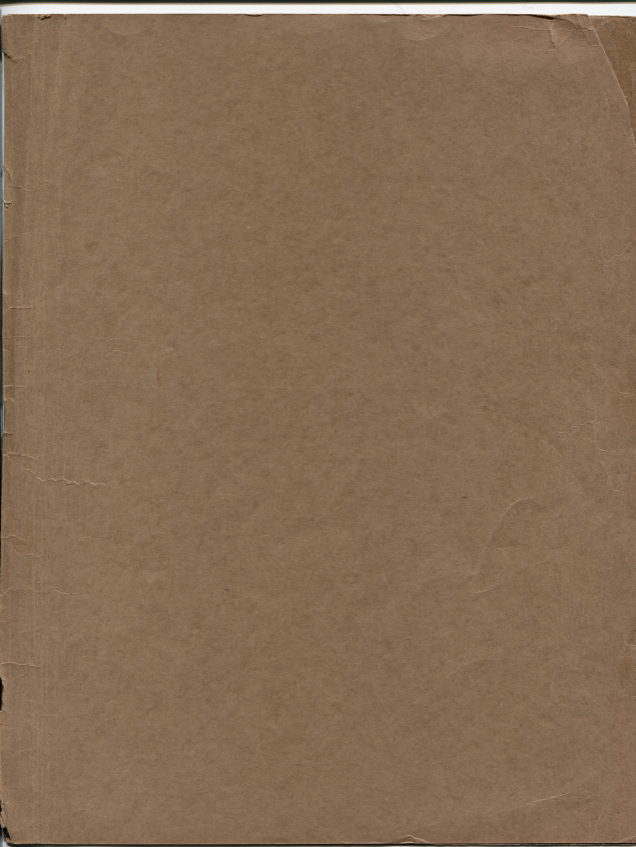
ER SLIDER BAR CENTER
THE REDUCTION
INSTANT OF 1.
UPPER SLIDER BAR CENTERS.

.745"
.098"

.3725" — UPPER BAR
.098" CONSTANT.

.2745"
ON UPPER SLIDER BAR
ION 1.

DRAWING
7561



40 YEARS *The Mark of* FINE MACHINE TOOLS

